

NASA GROUND COMMUNICATIONS

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ABSTRACT

As part of the Communications Requirements and Constraints, NASA's two major Ground Data Networks were briefly described.

The NASA Communication Network, called NASCOM, is the worldwide operational telecommunications system which interconnects as the tracking and telemetry acquisition sites, launch areas, mission and project control centers, data capture facilities, and network control centers in support of space flight. Currently, the NASCOM network contains over 2 1/2 million circuit miles using satellite, terrestrial, and submarine cable leased links; more than 630 circuits connect 139 domestic and foreign sites. The network is engineered and controlled at the Goddard Space Flight Center (GSFC) with major switching centers in Australia, Spain, and at the Jet Propulsion Laboratory (JPL) in California.

All kinds of communications traffic is supported, from low rate digital data and voice to narrow and wide band analog and digital at rated up to tens of megabits. NASCOM is transitioning to an all digital network with wideband links which utilizes improved technology in the competitive market place.

For the Space Station era, NASCOM plans are set for higher data rate service (up to 300 Mbps) utilizing data packet switched technology (CCSDS standards). Increased use of fiber optics is expected in a much more diverse network topology.

The second major ground network, the Program Support Communications Network (PSCN), interconnects all NASA Centers and NASA contractor

locations for intercenter non-operation communications. The primary functions are to transport voice, video, data and facsimile information for intercenter coordination, and to provide user access to space science and applications data bases. Currently, the PSCN contains almost 400 thousand circuit miles using satellite and terrestrial links, supporting many teleconference rooms and high and low speed FAX stations and a packet switched at 35 locations. This network is engineered and managed at Marshall Space Flight Center (MSFC).

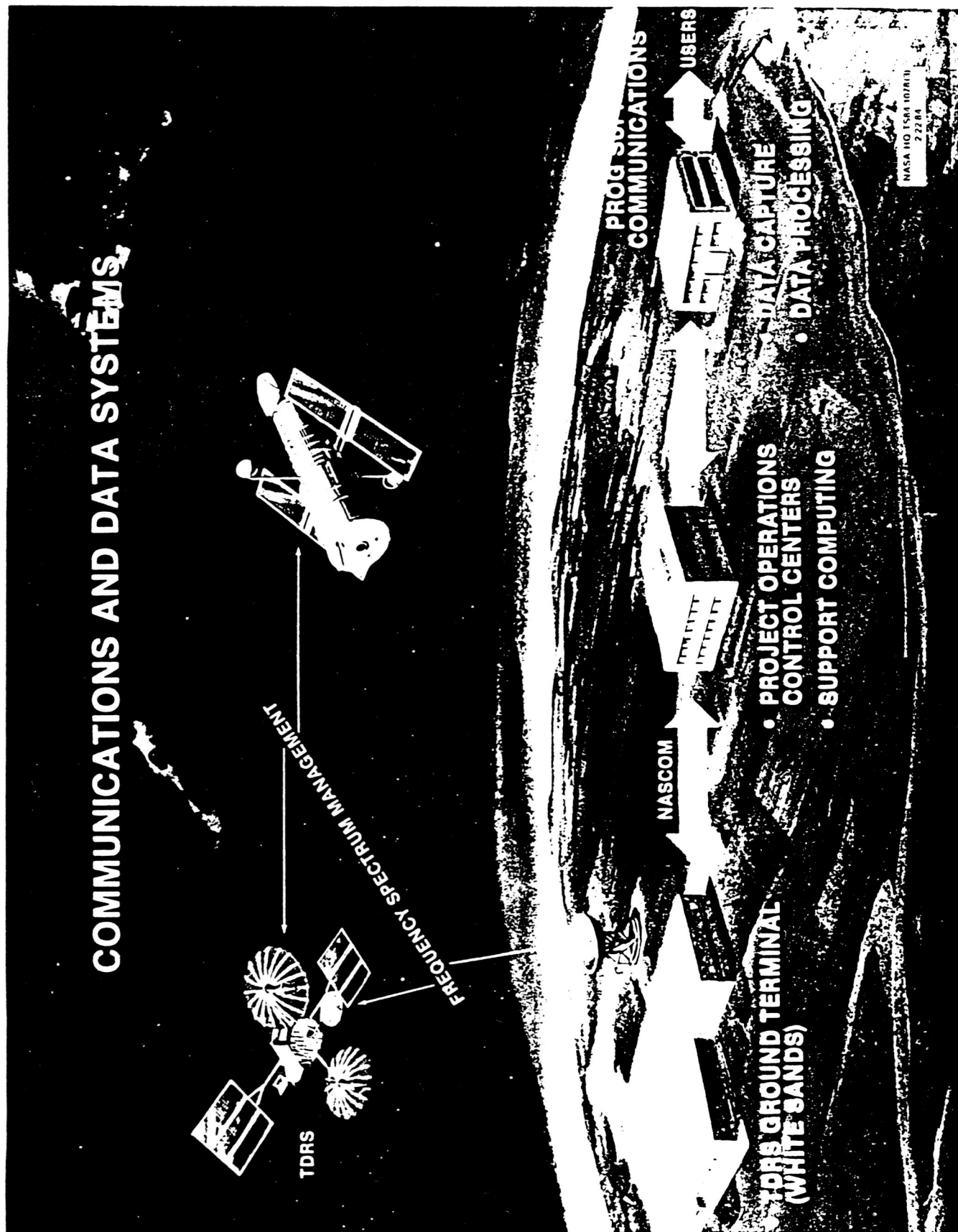
Individual data rates covered are from 110 bps to 56 Kbps, 388 different types of computers and terminals are accommodated, and more than 3000 mail boxes are provided for NASA's TELEMAL network. A computer networking subsystem allows resource sharing among the four aeronautics and space technology centers scientific mainframe computational centers.

For the Space Station era, PSCN plans address the significant increase in forecast requirements for science data distribution and access to the Numerical Aerodynamics Simulator, and increased use of the Video Teleconference System.

For communications in general, a recent NASA life cycle cost analysis predicts total data volume for NASA science missions to increase as much as two orders of magnitude, by the year 2000. Obviously, costs for telecommunications will not be allowed to keep pace, so creative concepts such as data compression and information reduction are sorely needed.

NASA TELECOMMUNICATIONS

NASA OPERATIONAL COMMUNICATIONS (NASCOM)



NASA TELECOMMUNICATIONS

NASCOM

DEFINITION: NASCOM OPERATIONAL TELECOMMUNICATIONS INTERCONNECT NASA'S FOREIGN AND DOMESTIC TRACKING AND TELEMETRY ACQUISITION SITES; LAUNCH AREAS; MISSION/PROJECT OPERATION CONTROL CENTERS; SCIENCE DATA CAPTURE FACILITIES; AND NETWORK CONTROL CENTERS.

- **A PRIMARY FUNCTION IS TO TRANSPORT SPACECRAFT TELEMETERED DATA AND DATA FOR COMMAND, CONTROL, TRACKING, ORBIT DETERMINATION, AND ACQUISITION OF SPACECRAFT**
- **NASCOM IS EXEMPT FROM THE FIRMR; HOWEVER, NASCOM FOLLOWS ALL APPLICABLE PROCUREMENT REGULATIONS IN ACQUISITION PROCESS**
- **NASCOM IS A MAJOR NATIONAL COMMUNICATIONS SYSTEM (NCS) ASSET**
- **MANAGED AND CONTROLLED BY THE GODDARD SPACE FLIGHT CENTER**

NASA COMMUNICATIONS

NASCOM - CURRENT DESCRIPTION

- o OVER 2 1/2 MILLION CIRCUIT MILES - DOMESTIC AND FOREIGN;
SATELLITE, TERRESTRIAL, AND SUBMARINE CABLE
- o 630 CIRCUITS TO 139 STATIONS
 - VOICE, DATA, VIDEO
 - ANALOG, DIGITAL
 - NARROW BAND, WIDE BAND
- o 35 COLLOCATED DOMSAT STATIONS AT 11 NASA SITES
- o BROADCAST MODE VIDEO SYSTEM TO ALL NASA CENTERS
- o CONTROL CENTER - GSFC
- o MAJOR SWITCHES AT AUSTRALIA, SPAIN, AND JPL
- o NEARLY ALL LEASED CIRCUITS

NASA TELECOMMUNICATIONS

FUTURE COST GROWTH

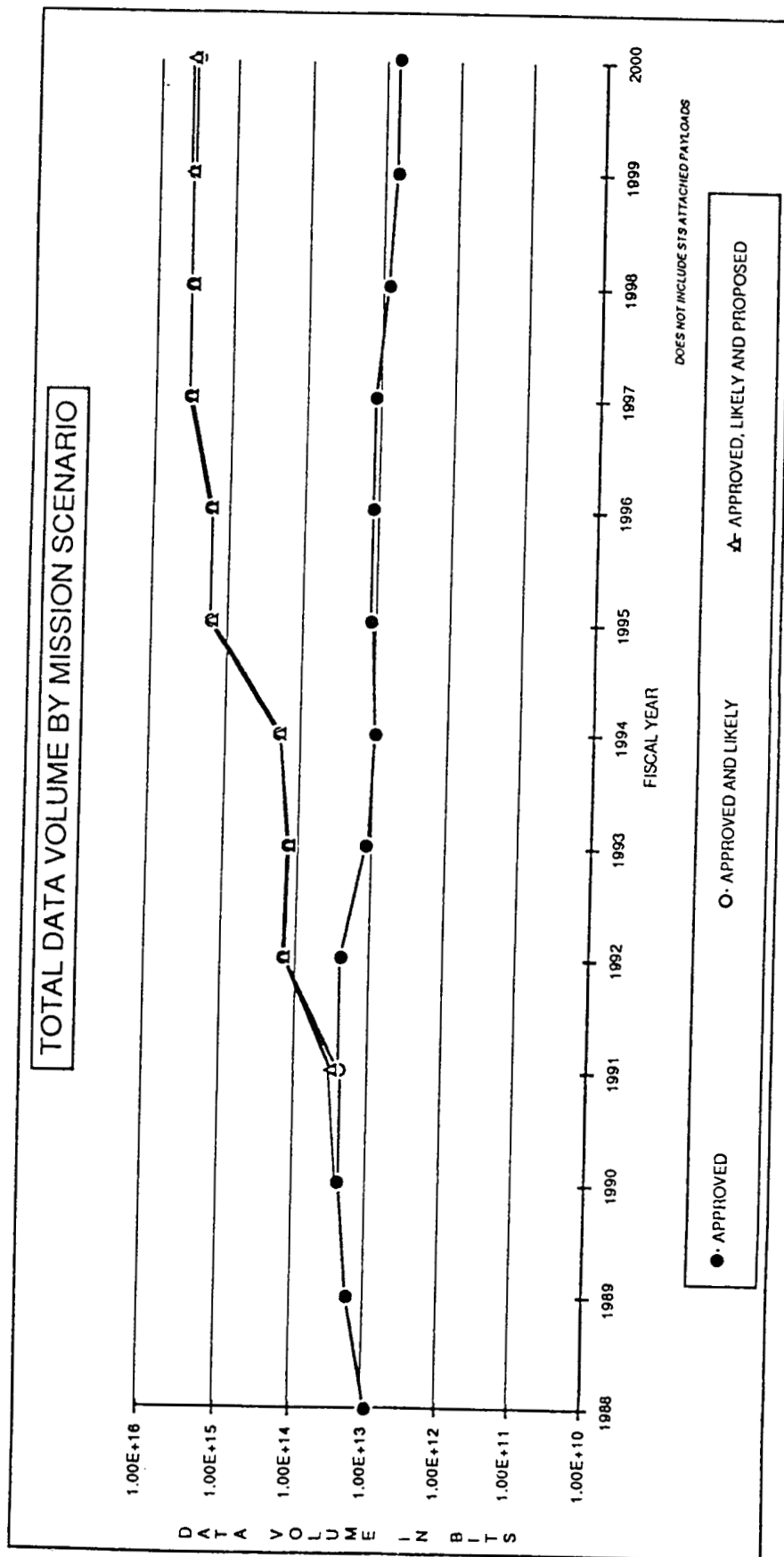
- o NASCOM WILL INCREASE SLIGHTLY BECAUSE OF INCREASED BANDWIDTH FOR SPACE STATION (LESS THAN 30%) .
- o COSTS IN TELECOMMUNICATIONS TEND TO REMAIN STABLE BECAUSE OF COMPETITIVENESS IN MARKET PLACE. THE COST PER BIT CONTINUES TO DECREASE.
- o DATA VOLUME EXPECTED TO INCREASE BY TWO ORDERS OF MAGNITUDE; HOWEVER, BUDGETED COSTS MUST REMAIN BELOW A 30% GROWTH.
- o DATA COMPRESSION, INFORMATION REDUCTION, OR CREATIVE CONCEPTS WILL BE REQUIRED.

Taken From:

Life Cycle Cost Analysis for NASA
Science Data Handling 1988-2000.

Dec. 23, 1987

A report to the HUD-Independent Agencies
Subcommittee of the Committee on
Appropriations of the United States Senate.



NASA COMMUNICATIONS

NASCOM NEAR-TERM PLANNING FOR SPACE STATION ERA

- o INCREASED WIDEBAND DATA SYSTEM USING DATA PACKET SWITCHED TECHNOLOGY (CCSDS)
- o AVERAGE DATA RATES ON BASELINE SYSTEM APPROACHING 90 MBS FROM WHITE SANDS TO JSC, GSFC, MSFC, WEST COAST
- o MAXIMUM DATA RATE OF 300 MBS WHEN REQUIRED
- o NETWORK TOPOLOGY BEING STUDIED TO USE ALL FIBER OPTICS TECHNOLOGY
- o COST EFFECTIVENESS ARCHITECTURE UNDER REVIEW

NASA TELECOMMUNICATIONS

NASCOM - TRANSITIONING TO:

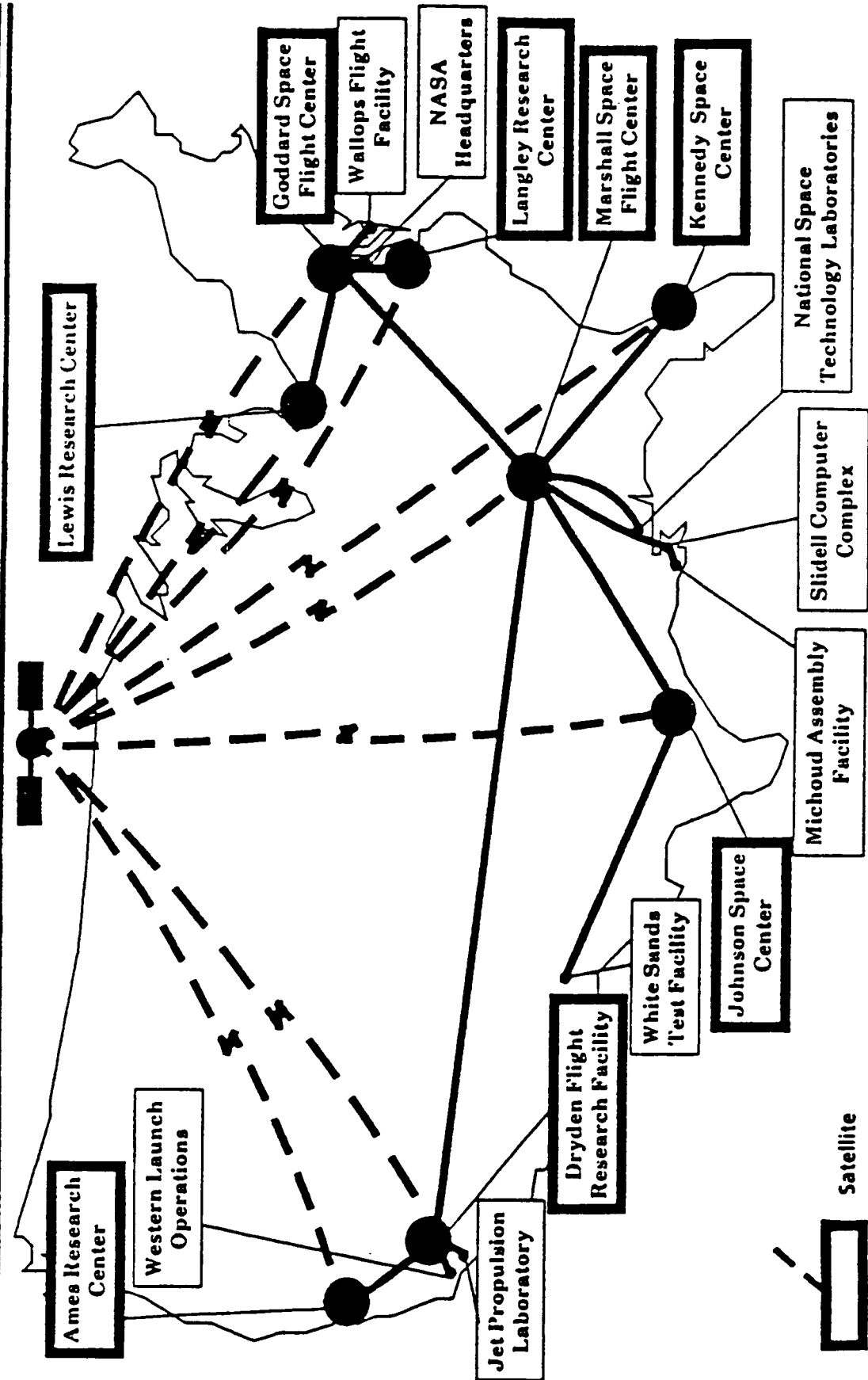
- **A COMPLEX COMMON USER NETWORK COMPRISED OF WIDEBAND DIGITAL LINKS**
- **THESE LINKS WILL:**
 - **PROVIDE ACCOMMODATION FOR TDRSS BASELINE (4-10 MBS)
TDRSS WIDEBAND (50 MBS)**
 - **UTILIZE TDMA TECHNIQUES FOR DEMAND ASSIGNED VOICE, HIGH SPEED DATA AND VIDEO**
 - **UTILIZE FIBER OPTICS FOR WIDEBAND INTERFACES AND LOCAL DISTRIBUTION**
- **CAN EXPECT LONG TERM STABILIZATION OF OPERATIONS**
 - **IMPROVED TECHNOLOGY**
 - **COMPETITIVE MARKET PLACE**

NASA TELECOMMUNICATIONS PROGRAM SUPPORT COMMUNICATIONS (PSC)

**DEFINITION: PROGRAM SUPPORT COMMUNICATIONS
INTERCONNECT ALL NASA CENTERS AND NASA
CONTRACTOR LOCATIONS FOR INTERCENTER
NON-OPERATIONAL COMMUNICATIONS.**

- **A PRIMARY FUNCTION IS TO TRANSPORT VOICE, VIDEO,
DATA, AND FACSIMILE INFORMATION FOR INTERCENTER
COORDINATION FUNCTION AS WELL AS USER ACCESS TO
NASA MAINTAINED SPACE SCIENCE AND APPLICATIONS
DATA BASES**
- **PSC FOLLOWS ALL APPLICABLE GSA FIRM'S AND FPR'S**
- **PSC IS A NATIONAL COMMUNICATIONS SYSTEM (NCS)
ASSET UNDER GSA**
- **PSC IS MANAGED BY THE MARSHALL SPACE FLIGHT
CENTER**

Program Support Communications - Backbone Network



NASA TELECOMMUNICATIONS

PSC - CURRENT DESCRIPTION

- **377,000 CIRCUIT MILES - BOTH SATELLITE AND TERRESTRIAL**
- **84 VOICE TELECONFERENCE ROOMS**
 - 4632 VOICE TELECONFERENCES IN FY 83
- **152 HI SPEED FAX STATIONS**
- **156 LO SPEED FAX STATIONS**
- **PACKET SWITCHED NETWORK AT 35 LOCATIONS**
 - DATA FOR SHUTTLE, LEGAL, MEDIA, IG
- **UTILIZES**
 - FACILITIES OF 14 COMMON CARRIERS IN 17 STATES
 - FACILITIES OF 6 SPECIALIZED COMMON CARRIERS IN 6 STATES
 - 388 DIFFERENT TYPES OF COMPUTERS AND TERMINALS
- **DATA RATES FROM 110 B/S TO 56 KB/S**
- **3133 MAILBOXES ON TELEMAIL NASANET**
- **NETWORK CONTROL AT MSFC**

NASA TELECOMMUNICATIONS

PSC PROCUREMENT

- CONSOLIDATED, IN A SINGLE PROCUREMENT, SEVERAL EXISTING CONTRACTS AND PLANNED PROCUREMENTS
- THE ELEMENTS WERE COMBINED TO ACHIEVE BETTER SYSTEMS ECONOMIES, EFFICIENCIES, COORDINATION, AND CONTROL THROUGH A SINGLE MANAGEMENT FOCUS.
- SINGLE CONTRACT FOR ALL ELEMENTS

NASA TELECOMMUNICATIONS

PSC CONTRACT ELEMENTS

- PROGRAM SUPPORT COMMUNICATIONS NETWORK (PSCN) - INTEGRATED COMMON USER NETWORK
- COMPUTER NETWORKING SUBSYSTEM - PROVIDES CAPABILITY OF THE 4 AERONAUTICS AND SPACE TECHNOLOGY CENTERS SCIENTIFIC MAINFRAME COMPUTATIONAL COMPUTERS FOR RESOURCE SHARING
- MARSHALL SPACE FLIGHT CENTER (MSFC) LOCAL TELEPHONE SYSTEMS (HUNTSVILLE, SLIDELL COMPUTER COMPLEX, MICHoud ASSEMBLY FACILITY) - DIGITAL VOICE AND DATA SYSTEMS TO REPLACE AND UPGRADE THE PRESENT TELEPHONE COMPANY SYSTEMS.
- MSFC TELECOMMUNICATIONS MISSION SERVICES - ENGINEERING AND OPERATIONAL SERVICES TO SUPPORT MSFC INTRA CENTER COMMUNICATIONS
- FTS - INTERCITY VOICE SERVICE BETWEEN NASA CENTERS.

NASA TELECOMMUNICATIONS
PSC CONTRACT

- AWARDED TO BOEING COMPUTER SUPPORT SERVICES (BCSS) - MARCH 31, 1985
- BCSS SUBCONTRACTORS - BAMSI, RCA SERVICE COMPANY
- 5 YEAR CONTRACT WITH OPTION FOR AN ADDITIONAL 5 YEARS

NASA TELECOMMUNICATIONS PSCN CHARACTERISTICS

- NO SINGLE POINT OF FAILURE
- ALTERNATE ROUTING
- DES ENCRYPTION GATEWAY TO GATEWAY
- USE TDRSS C-BAND - IF APPROVED
- STRONG NCC AT MSFC FOR END TO END TEST AND
DIAGNOSTICS

NASA TELECOMMUNICATIONS

PSCN NEAR-TERM PLANNING FOR SPACE STATION ERA

- o SIGNIFICANT INCREASE IN FORECASTED REQUIREMENTS
- o MAJOR REQUIREMENTS AND COST GROWTH
 - o SCIENCE DATA DISTRIBUTION
 - o NUMERICAL AERODYNAMIC SIMULATOR (NAS)
 - ACCESS TO NAS FROM NASA AND NASA SPONSORED LOCATIONS
- o INCREASED USE OF VIDEO TELECONFERENCING SYSTEM